Space Weather Technical Forecast

Issued on Thursday 31 October 2024 at 12:39 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Isolated M-flares expected, a chance of X-class flares. S1 Minor Storm easing.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with peak flare M7.2 at 30/2053 UTC from AR3878 in the northeast, which has a persistent delta spot on its trailer and some weak flux emergence amongst its intermediate spots. This is one of thirteen regions currently on the Earth-facing disc. AR3876 in the southwest is now showing some signs of decay and maturing into a simpler bipolar region. AR3869 in the southwest is currently relatively simple, albeit the opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"). This region is currently seeing the main negative trailer and positive leader spots move closer, and as this occurs, there is also an increased potential for notable flares. Additionally, a new unnumbered spot is forming in the southwest, south of AR3876, and two small unnumbered spots are emerging over the eastern limb in the southern hemisphere. The remaining regions are relatively stable and simpler in structure.

No Earth-directed CMEs were observed in available imagery. A broad coronal dimming was observed across the western disc around 30/1250 UTC, but no clear CME has been identified further analysis is ongoing. No CME has yet to be observed from the M7.2 flare.

Solar Wind / Geomagnetic Activity: Ongoing fast winds were observed, likely associated with CH85, which is now just on or over the west limb. Solar wind speeds, observed by ACE at L1, were slightly elevated to elevated, but also highly variable, between 480-550 km/s. Density was below average. Interplanetary Magnetic Field (IMF), Bt, was weak around 5-8nT, with the north-south component, Bz, varying weakly between -8nT and +7nT. Phi angle was predominately negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at S1 Minor Radiation Storm throughout, easing from around 51pfu at 30/1200 UTC, to 20pfu by 31/1200 UTC. High energy electron flux (greater than 2MeV) observed by GOES16 was Background to Moderate. The associated 24-hour fluence was well below the Active threshold, with 4.73e6 integrated flux observed at 31/0000UTC.

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Four-Day Space Weather Forecast Summary

Solar Activity: Moderate activity is expected to continue through the period, with isolated M-class flares expected and a chance of an isolated X-class flare.

Solar Wind / Geomagnetic Activity: There are no CME arrivals currently expected, however given the number of active regions and filaments on the disc, this may change at short notice. Current fast winds expected to slowly ease through days 1-2 (31 Oct-01 Nov). CH86/+ may cause further enhancement back to elevated levels through the latter part of day 3 (02 Nov). Mainly Quiet geomagnetic activity is expected, with isolated Unsettled intervals. There is a slight chance of Active to G1 Minor Storms later on Day 3 (02 Nov), should connection to CH86/+ occur, with perhaps a greater likelihood of connection by day 4 (03 Nov).

Energetic Particles / Solar Radiation: The high energy proton flux at GOES-18 is currently at S1 Moderate Radiation Storm, but slowly declining, and likely falling below this level either late day 1 (31 Oct) or through day 2 (01 Nov). However, any further notable flares will bring the potential for further enhancement. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active.

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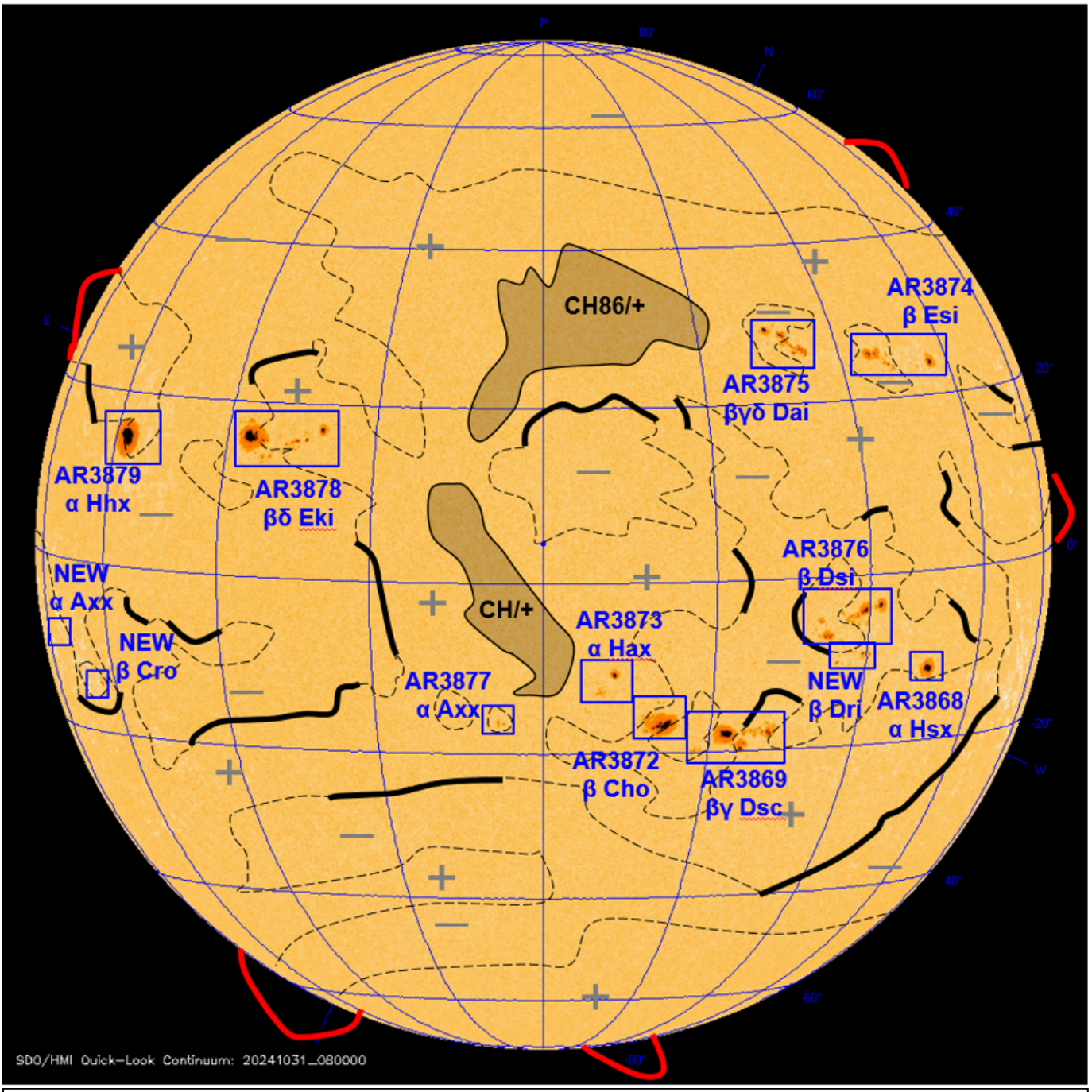
Figure 1: Solar Synoptic Map 31/0800 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are currently no Earth-directed CMEs expected. However, given recent imagery issues and the number of filaments on the Earth-facing disc, along with the continued chance for notable flares, this has the potential to change at short notice and is lower than usual confidence.

Current fast winds, most likely associated with CH85/-, are expected to slowly ease through days 1-2 (31 Oct-01 Nov), but may persist at slightly elevated levels. CH86/+, or the unnumbered coronal hole to its south, may cause further enhancement back to elevated levels through the latter part of day 3 (02 Nov). While this feature is a recurrent one, it appears larger and more prominent on this rotation, which suggests that the current solar wind increase might be underestimated by the MOSWOC ENLIL model. Overall however, MOSWOC ENLIL is considered to be giving relatively good guidance.

Mainly Quiet geomagnetic activity is expected, with a isolated Unsettled intervals. There is a slight chance of Active to G1 Minor Storms later on Day 3 (02 Nov), should connection to CH86/+ occur, with perhaps a greater likelihood of connection by day 4 (03 Nov).

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	20	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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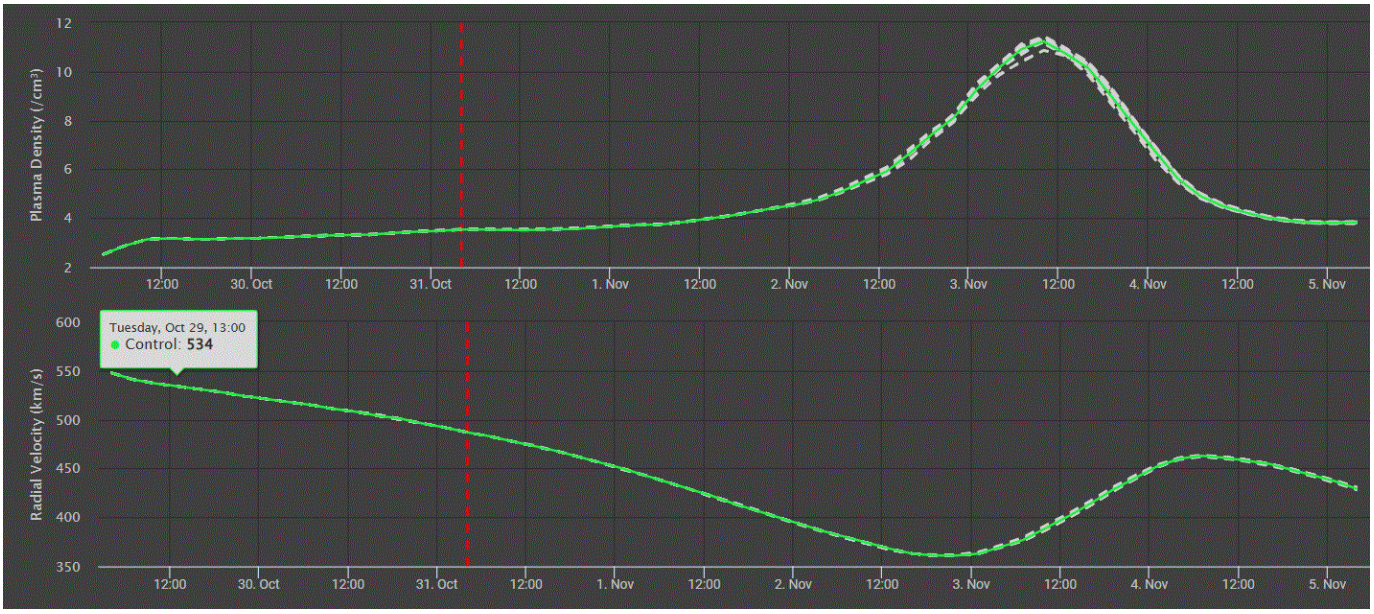
Figure 2: MOSWOC Enlil ensemble



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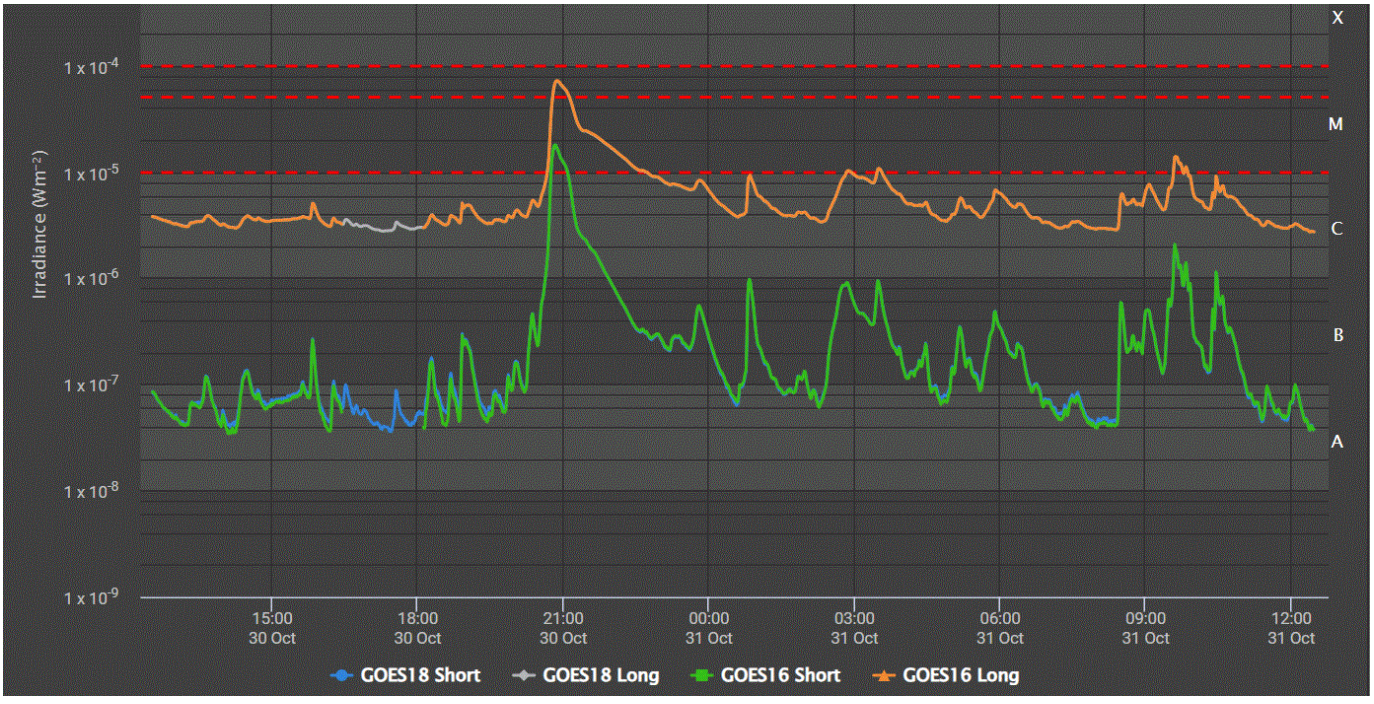
Radio Blackouts - X-Ray Flares

Generally Moderate activity is expected to continue through the period, with occasional M-class flares expected and a chance of an isolated X-class flare.

There are thirteen active regions, consisting of ten numbered and three unnumbered regions. AR3878 is the most likely flare source, with a persistent delta spot on its trailer and some weak flux emergence amongst its intermediate spots. AR3876 in the southwest is now showing some signs of decay and maturing into a simpler bipolar region. AR3869 is currently relatively simple, albeit the opposite polarity to what would be expected for a southern disc sunspot ("anti-Hale"). This region is currently seeing the main negative trailer and positive leader spots move closer, and as this occurs, there is also an increased potential for notable flares. Additionally, a new unnumbered spot is forming in the southwest, south of AR3876, and two small unnumbered spots are emerging over the eastern limb in the southern hemisphere. The remaining regions are relatively stable and simpler in structure.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	80	80	80	80
Very Active	R3-R5 (X Class)	No	25	25	25	25

Figure 3: GOES 16-18 X-ray Trace



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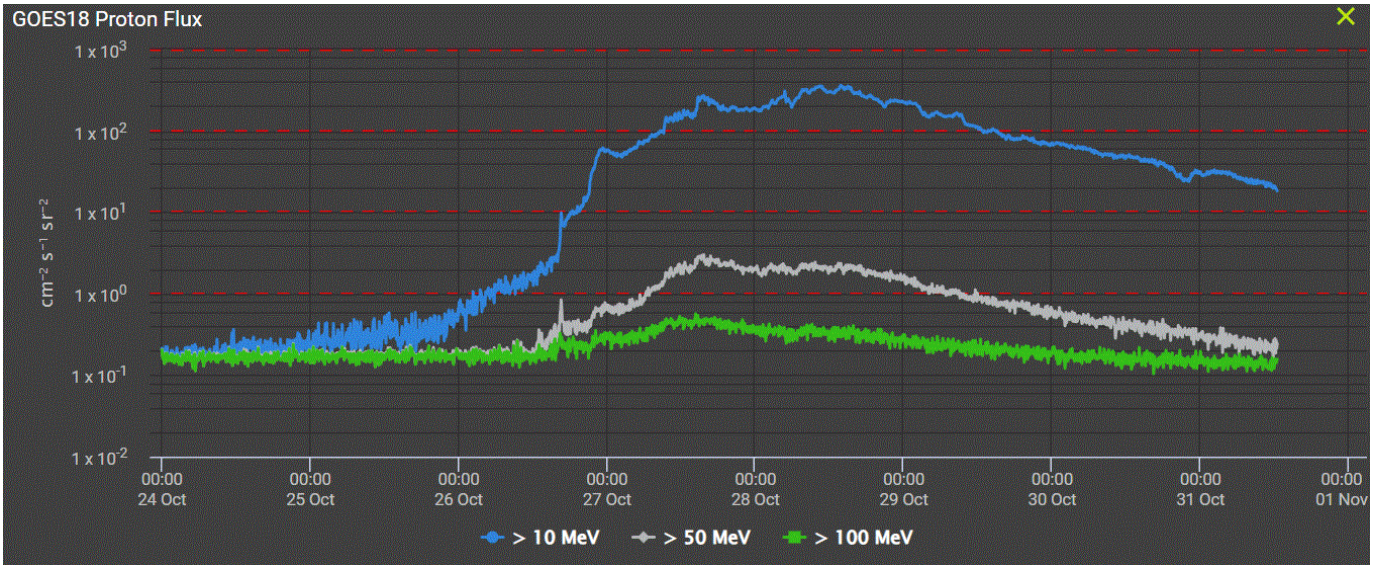
Solar Radiation Storms (High Energy Protons)

Recent CME and X-flare activity elevated the high energy proton flux at GOES-18 over the previous day, which after peaking at S2 Moderate Radiation Storm on 29 Oct, is now easing. This is now at S1 Minor Radiation storm level and will likely fall below this level either late day 1 (31 Oct) or through day 2 (01 Nov).

Further enhancements remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions in the south-centre disc, plus AR3876 to the northwest of this cluster. Notable flares are also possible from AR3878 in the northeast, and while less likely produce observable protons at Earth, this cannot be ruled out.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	Yes	99	60	20	20
Very Active	**≥ S3 ***	No	5	5	5	5
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: GOES-18 >10 MeV >50 MeV and >100 MeV Proton Flux over the last 7 days.



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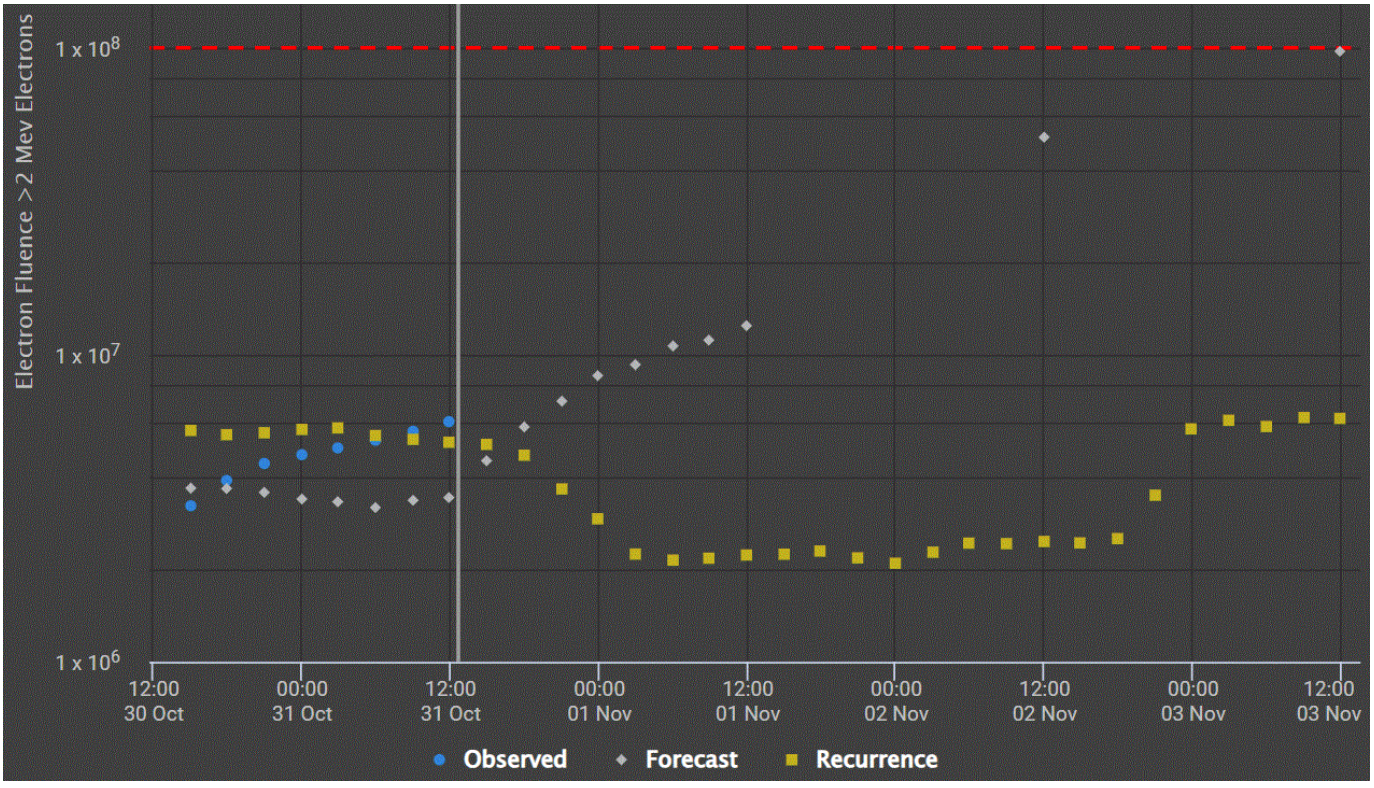
High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected.

The associated 24-hour fluence is currently expected to remain well below Active throughout the period, with the MOSWOC REFM forecast though to be providing reasonable guidance to staying below this Active level, although is believed to be over-estimating the forecast fluence towards the end of the period.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ 1×10^{8}**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ 1×10^{9}**	No	1	1	1	1

Figure 5: GOES-16 >10 MeV 24 hour electron fluence with MOSWOC REFM and Recurrence



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